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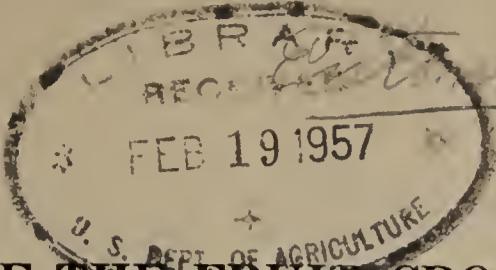
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SPRAY TO SAVE THE FRUIT CROP FROM INSECTS AND DISEASES.

Maximum Production of Paramount Importance—Specialists Advise Methods for Control of Moths, Caterpillars, Aphids, Scale, Curculio, Scab, Blotch, and Rots—Treatment for Apple, Peach, Plum, and Cherry—Spraying Schedules.

By A. L. QUAINTE, *Bureau of Entomology*, and JOHN W. ROBERTS, *Bureau of Plant Industry*.

Fruit, either in fresh, dried, canned, preserved, or jellied form, is a food product of recognized value. The maximum production of good fruit at this time is, therefore, of paramount importance. Directly concerned in the production of such fruit are spraying operations for the control of various insects and diseases.

Owners of commercial orchards have long recognized the importance of spraying, but there are many small orchards and so-called home orchards, the owners of which have not adopted spraying operations, or do not give sufficient attention to the work. The uncared-for condition of such orchards is too often revealed by the great number of windfall fruits and the inferiority of that which remains on the trees.

No single feature of orchard practice yields so high a percentage of benefit as spraying, often increasing the value of the product several hundred per cent. Every fruit grower, large or small, has it within his power to save his fruit from loss by insect and fungus pests, and thus add materially to the food supply of the nation. Spraying is now recognized by progressive growers as an exceedingly cheap form of insurance, not only protecting the fruit during the growing season, but insuring its proper keeping in storage.

SPRAYING THE APPLE.

The apple is grown over a very large territory and is our most important and valuable fruit crop, and when properly sprayed and handled will keep in storage for months.

Insect Pests.

The codling moth.—The codling moth is the dirty white or pinkish caterpillar which feeds within the fruit, mostly around the core, resulting in a large number of windfalls during the summer and in wormy fruit at harvest time. In the absence of treatments this insect will destroy each year a large proportion of the crop. Fortunately it yields readily to treatments, and a high percentage of benefit follows through spraying operations against it as outlined in the apple spraying schedule below.

The plum curculio.—This little snout beetle attacks various fruits, as the apple, peach, plum, cherry, etc. Early in the

spring the beetles puncture the little apples for feeding and egg laying purposes, causing much of the fruit to fall, and the fruit which remains on the trees becomes knotty and misshapen as it grows. The curculio is notably worse in neglected orchards, as in orchards which are in sod and more or less grown up in weeds and trash. In order to effect a satisfactory control of the curculio by sprays, these unthrifty conditions must be corrected.

The apple maggot.—This insect, often known as the "railroad worm," railroads or mines the pulp of the apple, making brownish patches or trails. Several maggots in the fruit will reduce the pulp to a filthy mass merely held together by the skin. Its injuries are confined largely to the Northeastern States. Present evidence indicates that the apple maggot may be controlled by the application of arsenical sprays to the fruit and foliage during early July, and some observers hold that routine orchard spraying is effective in obviating important injury. Dropped wormy fruit should be promptly collected and destroyed.

Apple aphids.—Principally three species of aphids attack the fruit and foliage of the apple, namely, the rosy aphid, the green apple aphid, and the oat aphid. The rosy aphid is especially injurious to the blossom clusters and causes the fruit to become knotty and distorted or to fail to properly thin out in the clusters, resulting in undersized fruit. The oat aphid is of relatively little importance, though the green apple aphid may seriously check the growth of young trees during the summer when abundant on the shoots and foliage. These aphids winter on the apple trees in the egg condition, the young hatching as the buds are breaking in the spring. They are best controlled by the use of 40 per cent nicotine sulphate used at the rate of three-fourths pint to 100 gallons of spray. If the treatment for the San José scale be delayed the nicotine may be added to the strong lime-sulphur wash, effecting combination treatment for these two pests. The nicotine may also be added to advantage to the first scab treatment of the spray schedule.

Leaf-eating caterpillars.—Various leaf-eating caterpillars, as canker worms, tent caterpillars, and the like, are more or less abun-

dant in orchards each year in different parts of the country. These caterpillars, as a rule, are kept well in check by the use of arsenical sprays.

Scale insects.—The San José, oyster-shell, and scurfy scales are very generally present in apple orchards throughout the country. The San José scale is by all odds the most injurious, and in the absence of annual treatments will destroy or greatly injure the trees. An individual scale is about the size of a pin head and has a nipplelike prominence in the center. When abundant the scales literally incrust the limbs and branches, to which they give an ash-gray appearance. Badly infested bark when cut into usually shows a reddish color. These scale pests are very successfully controlled by the use of strong sprays applied during the dormant period of the trees, as indicated in the schedule of applications.

Diseases of the Apple.

Apple scab.—This is the most destructive disease of the apple and is almost universally distributed. It appears very early in the season and causes not only grayish or brownish unsightly spots on the fruit, but often causes cracking and dwarfing of the fruit. It also appears as black blotches on the leaves. It is a cool climate disease and hence is most destructive in the more northern apple-growing regions. It is well controlled by spraying according to the methods outlined hereafter.

Bitter-rot.—Bitter-rot is typically a southern apple disease, and in the regions in which it occurs it is one of the most dreaded. It does not appear until the weather has become hot, this date being usually about the 1st of July, and is one of the hardest of all diseases to control. The rotted spots, with the pink or dark-colored concentric circles of fruiting postules, are typical of this disease. The removal of the limb cankers and mummified fruits in which it lives over from season to season is an important aid to control by spraying. In the East Yellow Newtown (Albemarle Pippin) is especially susceptible to this disease. In the Middle West nearly all varieties are susceptible to some extent at least.

Apple blotch.—This disease begins in the early part of the growing season, but is not

conspicuous until nearly midsummer. It is distributed over the southern half of the apple belt and is to the South what the apple scab is to the North. It is most destructive in Kansas, Arkansas, Missouri, Kentucky, and southern Illinois. It occurs on fruit, leaves, and twigs, but is most destructive to the fruit. It appears on the fruit as an irregular brown spot with a hard roughened surface and a somewhat uneven margin. It grows very slowly and finally becomes somewhat sunken. In severe cases, especially on certain varieties, the fruit may finally become badly cracked. Ben Davis, Missouri Pippin, and Northwestern Greening are especially susceptible to this disease.

Sooty fungus and flyspeck.—Toward the end of the summer apples may become covered with large sooty blotches or areas of minute black spots. These diseases do not penetrate the apple skin at all, but injure the market value of the fruit by detracting very greatly from its appearance. These diseases are quite common in the moister parts of the United States and in unsprayed orchards often cause considerable financial loss. They are, in ordinary seasons, controlled by the sprayings applied for the control of other apple diseases.

Black-rot or ring-rot and leaf-spot.—These diseases are caused by the same fungus, and are controlled by cutting out the branches and twigs supplemented by the sprayings recommended for the other diseases. The applications recommended for scab control will control the leaf-spot, and those recommended for bitter-rot will greatly lessen the losses from black-rot.

Spray Schedules.

Dormant tree spraying.—During the dormant period of trees sprays may be used much stronger than at other times, and for this reason are especially advisable for the treatment of scale insects, blister mite, etc. Applications may be made after the leaves have fallen in the fall, during warm days in the winter, or in the spring before the new growth begins to appear. Where aphids are troublesome it is often practicable to delay the San José scale treatment until just as the buds are breaking, and by adding nicotine to the strong lime-sulphur spray effect a combination treatment for these two insects.

SUMMER SPRAYING.

First application.—Use lime-sulphur solution at the rate of $1\frac{1}{2}$ gallons to 50 gallons of water plus 2 pounds of arsenate of lead paste (or 1 pound of powdered arsenate of lead) just before the blossoms open. This is for apple scab, the plum curculio, canker-worms, the bud moth, case-bearers, and the tent caterpillar. Add one-half pint 40 per cent nicotine sulphate if apple red bugs are troublesome and if apple aphids are much in evidence.

Second application.—Use same spray as in first application as soon as the blossoms have

fallen. This is for the above-mentioned troubles as well as for the codling moth and leaf-spot. It is the most important application for both apple scab and the codling moth. In spraying for the codling moth at this time, the aim is to drive in the calyx end of each little apple a quantity of the poison, and, to accomplish this, painstaking work is necessary. Failure to do thorough spraying at this time for the codling moth cannot be remedied by subsequent applications.

Third application.—Use the same spray indicated above 3 to 4 weeks after the blossoms fall. This is the second treatment for codling moth and leaf-spot, and gives further protection against apple scab and certain insects. In orchards in which blotch has been prevalent this application should be made not less than 3 weeks after the blossoms have fallen. Where this disease has been severe, Bordeaux mixture (3-4-50) should be substituted for the lime-sulphur solution.

Fourth application.—Use Bordeaux mixture (3-4-50) and an arsenical 8 to 9 weeks after the petals fall. This is the first application for the second brood of the codling moth and for bitter-rot. In orchards in which bitter-rot has been a serious disease this application should be advanced about one week.

Fifth application.—Use Bordeaux mixture from 2 to 3 weeks after the fourth application. This is the second application for bitter-rot, and since it is very little extra expense to add an arsenical, this may be profitably done as a further protection against late-appearing larvae of the codling moth.

Sixth application.—Use Bordeaux mixture again 2 or 3 weeks after fifth treatment has been applied. This is the third application for bitter-rot and is ordinarily sufficient to carry the fruit through, but on specially susceptible varieties in bitter-rot sections, a treatment to be made 2 weeks later may be found necessary.

Seventh application.—In severe cases of bitter-rot a seventh application may be necessary, and in severe cases of blotch an extra treatment midway between the third and fourth applications is sometimes necessary.

NOTE.—In the more northern apple-growing sections the first four applications will, during ordinary seasons, be sufficient to protect the fruit from various insects and diseases mentioned. In the more central States, where bitter-rot and blotch are prevalent, the fifth and sixth applications will be necessary. In the case of summer apples, only the first three applications are necessary.

PEACH SPRAYING.

There are four or five serious insect and fungous pests of the peach effectively controlled by spraying. Notwithstanding the fact that the larger commercial growers throughout the country have adopted meas-

ures for the control of these troubles, there is still room for such improvement on the part of many orchardists, especially those having small home orchards. Although successful spraying of the apple has been practiced for many years, it is only recently that sprays have been developed which are effective and safe for the tender foliage and fruit of the peach and certain other stone fruits. The development of the combination spray of arsenate of lead and the self-boiled lime-sulphur mixture has been of enormous value to peach growers, and its use has placed the cultivation of this crop on a much sounder basis than heretofore.

Insect Pests.

The plum curculio.—This insect, already referred to under the head of apple, is the cause of a large amount of injury to the peach. Aside from the injury which it actually does to the fruit, its attack much favors the spread and infection of the fruit by brown-rot fungus. Its control is therefore especially essential in connection with remedial operations against brown-rot.

The San José scale.—This insect, also mentioned under apple insects, requires treatment on the peach. Applications should be made while the trees are dormant, and if spraying be delayed to just before the buds are due to swell the treatment also controls peach leaf curl. Winter strength commercial lime-sulphur solution is almost universally used in the case of the peach, since the fruit buds and twigs are more likely to be injured by oil sprays than is true of the pome fruits.

Diseases.

Leaf curl.—This disease affects the leaves of the peach, causing them to become reddened and curled. It begins quite early in the season and is easily controlled by the same treatment which controls scale insects.

Peach scab.—This disease is the ordinary black spot of freckles of the peach. It appears early in the summer, and when several spots run together and infections are numerous it gives the fruit a smutty appearance. Severely infected fruits are dwarfed or misshapen, and are often cracked so severely as to cause dropping. This disease causes more loss to growers than is ordinarily realized because infected fruits so often fail to attain their normal size.

Brown rot.—This is the ordinary rot of the peach which is so often very destructive at ripening time, and is the only peach rot of commercial importance. It is particularly destructive during warm, moist weather. Especially in the South it may sometimes cause the loss of practically the entire crop.

Schedule of Applications.

In the eastern half of the United States most of the peach orchards should be given the combined treatment of arsenate of lead and self-boiled lime-sulphur mixture for

curculio, scab, and brown rot. The curculio and brown rot are more especially troublesome in the South, whereas peach scab is worst in the Allegheny Mountain region and in the Northern States.

Midseason varieties.—The midseason varieties of peaches, such as Reeves, Belle, Early Crawford, and Elberta, should be sprayed as follows:

(1) With 2 pounds of arsenate of lead paste (or 1 pound of arsenate of lead powdered) per 50 gallons of water, to which has been added the milk of lime made from slaking 3 or 4 pounds of stone lime, about 10 days after the petals fall, or at the time the calyxes are shedding.

(2) With self-boiled lime-sulphur and arsenate of lead, two weeks later, or four to five weeks after the petals have been shed.

(3) With self-boiled lime-sulphur mixture four or five weeks before the fruit is due to ripen.

Late varieties.—The Salway, Heath, Billeu, and other varieties with a similar ripening period should receive the same treatment prescribed above, with an additional application of self-boiled lime-sulphur mixture alone to be applied three or four weeks after the second application.

Early varieties.—The Greensboro, Carman, Hiley, Mountain Rose, etc., and varieties of the same ripening period should receive the first and second applications only as prescribed for midseason varieties.

PLUM AND CHERRY SPRAYING.

Japanese plums should receive the same treatment as peaches having the same ripening season. Soap should be added in the third application to enable the spray to stick to the smooth plum fruits.

Cherries should receive the same treatment as early varieties of peaches, except that commercial lime-sulphur solution diluted at the rate of 1 gallon to 40 gallons of water should be used in place of the self-boiled lime-sulphur. Where leaf-spot has been severe this solution should also be used in the fruit treatment. For the control of leaf-spot, an application of the diluted lime-sulphur should also be made as soon as the fruit is picked.

Plums other than the Japanese varieties should receive the treatment outlined in the peach schedule, except that commercial lime-sulphur solution diluted at the rate of 1 gallon to 40 gallons of water is to be preferred to the self-boiled lime-sulphur.

SPRAY MATERIALS.

Arsenate of lead.—This arsenical comes on the market in paste and powdered form. In orchard spraying the paste is used at the rate of 2 pounds and the powdered lead at the rate of 1 pound to 50 gallons of water or fungicide, as dilute lime-sulphur solution. When used in water without a fungicide, the milk of lime made from slacking 2 or 3 pounds of stone lime should always be added

for each 50 gallons of spray to obviate danger of burning fruit and foliage. This poison may be obtained of various manufacturers or usually of local seedsmen, implement dealers, or druggists. Care should always be taken in the handling and storage of arsenicals to obviate the danger of poisoning persons or live stock. Where smaller quantities of the arsenical are desired, the proportions indicated should be followed.

Lime-sulphur solution.—Strong lime-sulphur solution is used as a dormant tree treatment for the control of scale insects and certain diseases, and in a much more dilute condition as a spray on trees in foliage for the control of various fungous diseases. Many growers prefer to purchase the commercial article, which comes on the market of a specific gravity of about .33° Baumé. This is used at the rate of 1 gallon to 7 or 8 gallons of water for winter spraying, and at the rate of 1½ gallons of water for use on apple and other pome fruits as a summer fungicide. In summer spraying the arsenate of lead and 40 per cent nicotine sulphate are added to the dilute lime-sulphur solution, thus permitting the treatment of sucking and biting insects and fungous diseases. Concentrated lime-sulphur solution can be made at home, which practice is followed by numerous growers. Those interested in this matter should write to the department for more explicit information than is feasible to give here.

Nicotine.—Nicotine is used for the control of certain sucking insects as plant lice, the apple red bugs, the pear psylla, etc. This product comes on the market of various grades, but the grade known as 40 per cent nicotine sulphate is mostly employed. This may be used alone in water to which has been added a little soap, or in lime-sulphur and arsenate of lead, or in Bordeaux mixture and arsenate of lead sprays. It is employed at the rate of from three-fourths to 1 pint per hundred gallons of spray.

Bordeaux mixture.—Bordeaux mixture is composed of 4 pounds of bluestone (copper sulphate) and 4 pounds of stone lime to 50 gallons of water. For early summer spraying the amount of bluestone may be reduced to 3 pounds to lessen risk of injury. To make Bordeaux mixture for use in an ordinary barrel sprayer, dissolve 3 to 4 pounds of bluestone in 25 gallons of water and in a separate container slake 4 pounds of stone lime and dilute to 25 gallons, then pour the solutions simultaneously through a strainer into the spray tank. Stock solutions, especially where large quantities are to be used, are desirable, since they save time. A stock solution of bluestone is made by dissolving it at the rate of 1 pound to 1 gallon of water. The bluestone should be suspended in a sack in the upper part of the barrel or other container, so that it is just beneath the surface of the water. It will be dissolved if left for a few hours in cold water and more rapidly in hot water. A stock solution of

lime may be made by slaking the lime in a little water and then diluting so that each gallon of water contains 1 pound of lime. Just before the stock solutions are used they should be stirred thoroughly. To make up Bordeaux mixture from stock solutions it is only necessary for 3 or 4 gallons of the stock solution of bluestone to be poured into a suitable container and 4 gallons of the stock solution of lime into a separate container, diluting each to 25 gallons and then pouring them simultaneously into the spray tank. Commercial Bordeaux may be used in place of the home-made product.

Self-boiled lime-sulphur mixture.—The self-boiled lime-sulphur mixture consists of 8 pounds of sulphur and 8 pounds of good stone lime to each 50 gallons of water, and is made as follows: The lime is placed in a barrel and enough water added to nearly cover it. As soon as the lime begins to slake, the sulphur should be added. Water should be added from time to time to form a thoroughly thick paste, which should be constantly stirred. As soon as the lime is entirely slaked, enough water should be added to cool the mixture, which is then ready to be strained into the spray tank, where it should be diluted to the proportions given above. The sulphur used may be in the form of "flowers," "flour" or "commercial ground," and should, if necessary, be run through a screen to break up lumps. Commercial substitutes for the self-boiled lime-sulphur may be used, but should not be confused with commercial lime-sulphur solution.

SPRAYING APPARATUS.

For the proper application of sprays some form of spray pump with suitable nozzles is absolutely essential. Most spray outfits are supplied with spray rods permitting the operator to direct the spray as desired. The hose should be of sufficient length to permit convenient spraying.

Spray outfits vary in size from small bucket pumps to gasoline power outfits for large scale operations. Bucket pumps answer well for small home orchards where but a few trees are to be sprayed. Where the orchard interest is larger, and especially where older trees are to be treated, a barrel pump is essential. A barrel pump may be purchased for from \$20 to \$30, depending on the equipment. In spraying, the outfit can be mounted upon a sled or placed in a cart or wagon. An outfit for operations on a still larger scale consists of a 100 or 200 gallon tank mounted upon a truck, having a strong double-acting hand pump mounted upon it. For large commercial operations, gasoline power outfits are largely used.

Information concerning dealers in spraying material and apparatus can be obtained from reliable horticultural journals.

Further information on orchard spraying may be obtained by writing to the United States Department of Agriculture or to your State experiment station.

CODLING MOTH TRAP.

New Device to Be Used in Place of "Banding" Method—Not a Substitute for Spraying.

A codling moth trap has been devised by E. H. Siegler, of the Bureau of Entomology, United States Department of Agriculture, to be used as a substitute for what is known as the "banding" method for destroying the codling moth. The banding method, in which a folded strip of burlap is wrapped around the tree trunk, demands a considerable amount of labor, and the new trap is designed to minimize this.

The trap affords an attractive place for the larvae to spin their cocoons, and it prevents the escape of the moths after they emerge from these. The trap, which consists of a burlap band covered by a strip of wire screen, is made as follows:

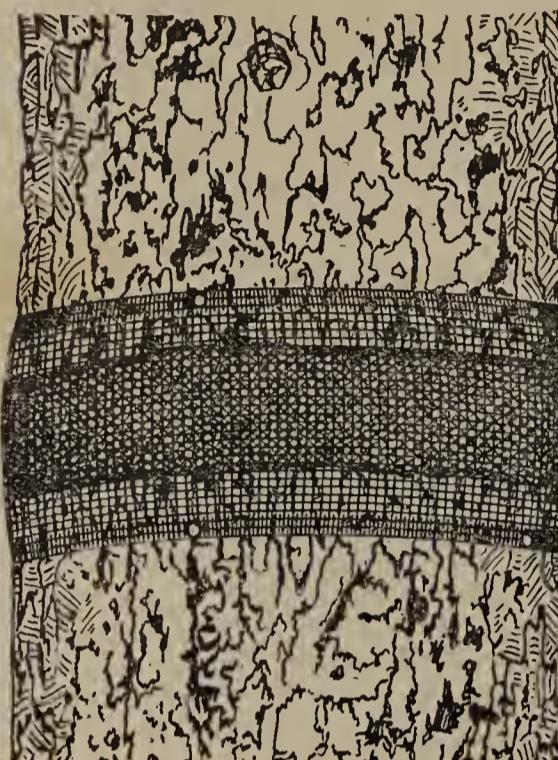
Strips of burlap 6 inches wide are folded into three thicknesses. The loose bark from the lower branches and trunk of the tree is removed and a strip of this burlap folded once around the trunk. It is held in place by large tacks, which should be driven in in such a way that the edge projects about one-fourth of an inch beyond the burlap. The burlap is then covered by black-painted wire screen with 12 meshes to the inch.

This is cut into strips 6 inches wide and the edges of each strip are folded twice, allowing one-fourth of an inch to each fold. The strip of screen should be long enough to allow for an overlap of 3 to 4 inches when placed

the burlap to the tree prevent the wire pressing against the cloth. To make sure that no moths may escape through openings along the edges of the trap or along the flap, a thin coating of pitch tar may be used. This material, when heated, may be applied readily with a brush.

The traps may be placed on the tree at any time during the winter or in the spring not later than one month after the petals have dropped. As long as no openings occur in them they will require no further attention. The codling moth larva, having completed its feeding in the fruit, seeks a place to spin its cocoon, and for this purpose generally crawls up or down a tree trunk. Meeting the trap, it enters through one of the openings in the mesh of the wire screen and spins its cocoon beneath the burlap band. When it emerges as a moth its larger size makes it unable to escape through the opening in the screen by which it entered the trap.

It must be clearly understood, however, that this trap is not a substitute for spraying, but merely an additional precaution. Despite the most careful spraying some larvae will invariably escape the poison, and the offspring of these are largely responsible for the damage to the fruit crop. By the use of the codling moth trap, in addition to thorough spraying, the majority of the unpoisoned larvae may be captured and injury by later broods will be materially reduced.



Codling moth trap.

around the trunk of the tree. The wire screen is placed over the burlap band and tacked to the tree in such a way that both the upper and lower edges fit snugly against the bark. The projecting tacks used tend to

